Small Explorer Library

LONG DURATION BALLOON OPPORTUNITIES

General Information

All scientific groups proposing long duration balloon missions can find more detailed information by requesting the **National Scientific Balloon Facility (NSBF) Long Duration Balloon (LDB) Flight Application** package or electronically accessing at "http://master.nsbf.nasa.gov/docs.html".

All science groups requesting Long Duration Balloon (LDB) support should be prepared to submit a LDB Flight Application immediately upon selection as a SMEX mission or approximately two years in advance of the requested support. The advance application for LDB flights is due to the long lead time required for operational planning, logistics, and interfaces with associated support organizations.

Systems Description

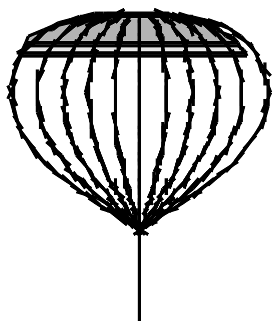
Balloon Vehicle

No proposals will be considered beyond the demonstrated capabilities for 29.47 MCF zero-pressure, and small superpressure balloons addressed below. No options to existing balloon designs that have been approved for operational use within the NASA Balloon Program or options that extend beyond the demonstrated capability of those balloons for LDB missions will be considered in response to this announcement.

Zero-Pressure Balloons

Currently the balloons most used for LDB missions are called zero-pressure balloons. The zero-pressure balloon carries the scientific instrument to a density altitude which is determined by the total mass of the system (suspended mass + balloon mass) divided by the fully inflated balloon volume. The balloon is only partially filled at time of launch and expands to its full volume as the balloon approaches its float altitude. NASA currently uses helium as the lifting gas. The zero-pressure balloon has openings to the atmosphere, called vent ducts, to release the excess gas called free-lift, which provides the lifting force during ascent. The balloon continues to float at the density altitude until there is a change in the radiation environment, such as sunrise/sunset, upwelling earth flux, etc. At sunset the gas cools, the volume decreases, and the balloon descends (~30-50 k-ft) to a lower equilibrium altitude based on atmospheric lapse rates and radiation environment. Altitude can be maintained by the reduction in total system mass through release of ballast which nominally amounts to ~8 percent/day. Flights are thereby limited by the total available mass that can be used as ballast.

W 29.47 mcf Balloon



Balloon Volume = 29.47 x 10^{6} ft^{3}

Inflated Height = 335 ft

Inflated Diameter = 424 ft

Gas Barrier = 0.8 mil LDPE

No. of Caps = 2

Balloon Mass = 3600 lbs

Float Altitude = 118 to 130 k- ft

<u>Superpressure Balloons</u>

A superpressure balloon is made with a non-extensible material and is a closed system to prevent gas release. By the time float altitude is achieved, it has converted the free-lift gas into superpressure. Variations in the radiation environment produce changes in the superpressure, but not in the balloon volume, therefore the balloon continues to float at the same density altitude. As long as the balloon is superpressured, it will continue to float at a constant density altitude. Flight durations of greater than one hundred days have been achieved with small superpressure balloons. The experience to date has been with total suspended loads (scientific instrument plus support hardware) of approximately 130 lbs. floating at an altitude of approximately 84,000-ft. (23 mbs). Data return is limited to on-board storage with possible later recovery or "real time" through Service Argos.

Ballooncraft (Gondola)

SIP (Support Instrument Package) Configurations:

There are three SIP configurations. One incorporates an INMARSAT-C/HF (High Frequency) Command and Telemetry system; the second uses TDRSS/HF systems; and the third, INMARSAT-C/TDRSS. The first and second configurations above are utilized only for flights in Antarctica and science requirements and flight trajectory determine which configuration is best. The INMARSAT-C/TDRSS configuration is used on all LDB flights at other locations. Both configurations incorporate Argos LEO satellite relay systems for low data rates (i.e. housekeeping status, etc.) INMARSAT-C, TDRSS, and Argos are over-the-horizon (OTH) telemetry systems. HF is a limited OTH command telemetry system.

Communication between the science instrument and the SIP is via RS-232. Scientists desiring higher data & command telemetry rates, than that offered by the current NSBF systems, have the option of providing their own telemetry systems, provided it passes compatibility testing with the SIP and flight control systems.

Polar Configuration (McMurdo, Antarctica):

The INMARSAT-C/HF SIP configuration will allow regional HF commanding commands transmitted from McMurdo, Antarctica. INMARSAT-C allows for commanding from either McMurdo or the NSBF at Palestine, Texas. The TDRSS/HF SIP configuration also allows TDRSS commands from the NSBF at Palestine, Texas via NASA's TDRSS network. TDRSS uplink commanding and downlink data is only available at the NSBF Operations Control Center.

Return telemetry is provided via INMARSAT-C, TDRSS, or Argos. INMARSAT-C return telemetry is transmitted at the rate of 256 bytes every 15 minutes. TDRSS return telemetry is 4 KB on a near-continuous basis. A science dedicated Argos Platform Transmitter Terminal (PTT) is offered which transmits 32 bytes every 60 seconds. Argos data is only available during periods of co-visibility with LEO satellites, which average about 160 cumulative minutes per day while the LEO satellites are in view of the balloon. While within line-of-sight (LOS) of the launch facility or during specially arranged LC-130 aircraft flybys, science data can be acquired via L/S-Band telemetry links for higher data rates (i.e. 50 KB NRZ PCM).

In addition to the aforementioned near "real-time" telemetry, science data is stored onboard SIP hard drives for recovery after flight termination.

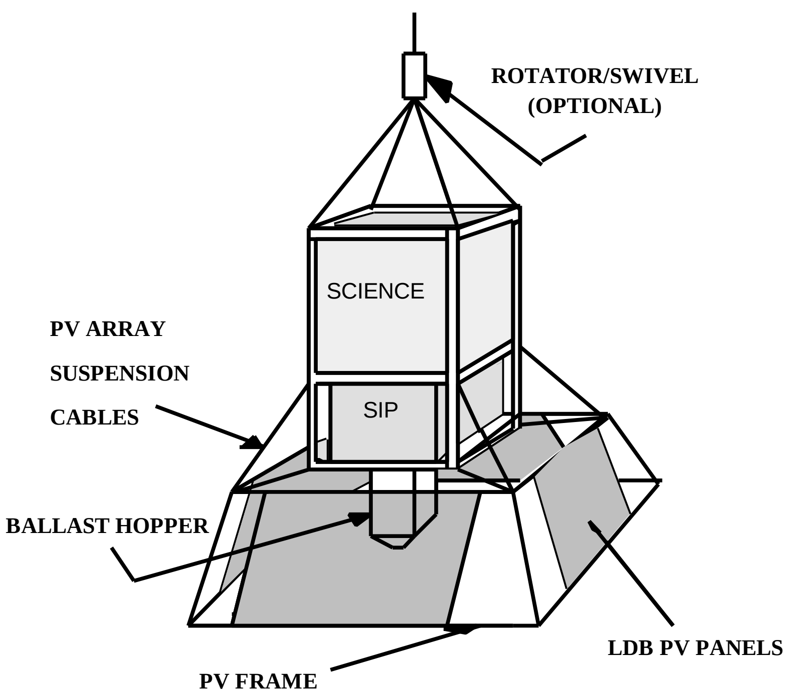
Mid-Latitude Configuration (Fairbanks, AK & Alice Springs, Australia):

The INMARSAT-C/TDRSS SIP configuration is the principle configuration for flights launched from Fairbanks or Alice Springs. Refer to the aforementioned discussion for telemetry rates. Detailed information is available via the aforementioned LDB Flight Application documentation.

Gondola Configuration:

Balloon gondolas (payloads) vary depending upon the experimenter's needs. The following drawing is a simple example (excluding science power photovoltaic array) for purposes of illustrating what a typical configuration would include. The SIP and suspended LDB PV array is thermally and electrically isolated from the science gondola frame.

The LDB PV array is a four-sided array. Because the LDB PV systems support mission-critical safety requirements, they are configured in this manner even when a sun-pointing rotator is flown. Factors influencing LDB PV array size include gondola height, Science PV array structure, and other factors impacting shading on the PV array. No shading of the PV array is allowed for any angle of the gondola with respect to the sun at any elevation. Factors impacting placement of all PV (science and LDB) panels include thermal, shading, and illumination considerations. Generally, heat sensitive components are never placed behind PV panels because extreme heat is radiated off the back of the panels.



A rotator or free swivel, either of which are optional on LDB flights from Fairbanks and McMurdo, must include electrical slip rings to accommodate the SIP's serial communications lines going to the Balloon Control electronics package above the gondola. Eight slip rings are required but it is recommended that spares be included.

For additional cost, the NASA Balloon Program can provide a sun-pointing rotator capable of suspending 6500 lbs. (This rotator will orient toward the sun throughout the day for the purpose of maintaining sun illumination on a set of power system photovoltaics mounted on one side of the gondola.)

A sun-pointing rotator is a requirement for LDB flights from Alice Springs to orient the photovoltaic system during the daytime. If a rotator is not provided by the experimenter, the Balloon Program Office will provide one but the experimenter will be charged for any damage or loss incurred.

All gondola configurations require consultation with, and concurrence by the NASA Balloon Program Office.

Future Capability

A new capability, called Ultra Long Duration Ballooning (ULDB) is under development by the NASA Balloon Program. Although ULDB will not be available to support the missions proposed under this AO, it is expected that the additional anticipated capability will generate some questions regarding these proposals. ULDB will utilize superpressure balloons, but using a radical new design and new material which will give the balloon vehicle an extended capability. These balloon vehicles are presently under development and their incorporation into the NASA operational Balloon Flight Program cannot be guaranteed. Therefore, they will not be offered for this announcement.

An additional feature of ULDB will be an integrated approach, similar to that of Spacecraft, to the design of the science and flight support systems. Proposers will be allowed to develop an integrated approach for the payload, i.e. no separate SIP package. However, proposers are advised to be cautious in using this approach because LDB requires that all flight control systems be electronically and electrically (including power), and thermally isolated from the science systems. Any integrated science approach would have to meet these requirements. Also LDB requires that all flight control systems must have a demonstrated performance record in balloon flight environment and be approved for operational flight use by the NASA Balloon Program. The only systems that meet these requirements are those currently being flown on NASA LDB flights.

Launch Sites, Flight Windows and Trajectories

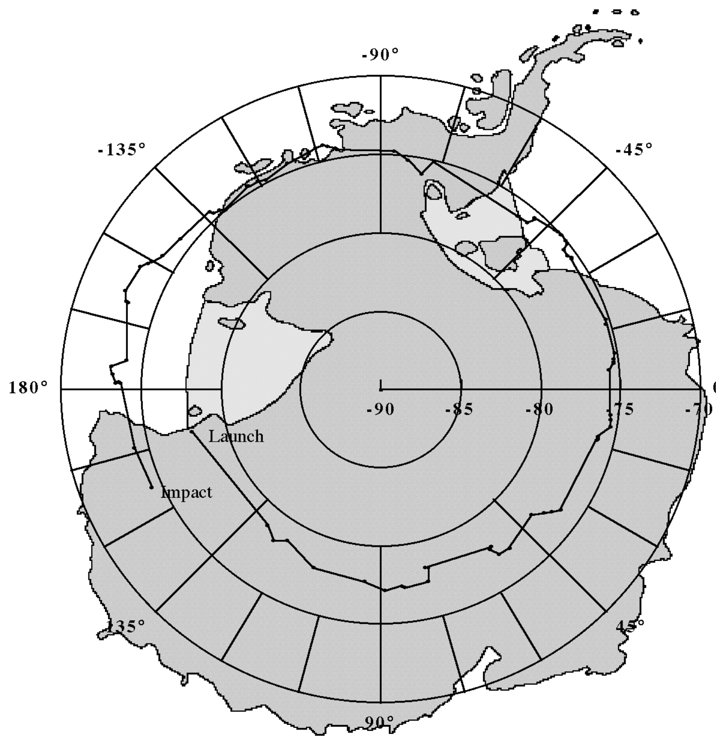
The Balloon Program is currently prepared to support LDB missions from McMurdo, Antarctica; Fairbanks, Alaska; and Alice Springs, Australia. Only McMurdo, and Fairbanks have a proven LDB circumnavigation flight history. Circumnavigational flights of missions from Alice Springs may be proposed and the NASA Balloon Program will make every effort to accommodate them. However, using demonstrated zero-pressure balloon capability and current balloon performance models, only flights from Australia to South America may be offered with reasonable reliability. Therefore, flights proposed from Alice Springs should include the contingency for flight termination and recovery in South America.

McMurdo, Antarctica:

Launches are conducted from what was formerly known as Williams Field located about seven miles from McMurdo on the Ross Ice Shelf. The launch site will be operated exclusively as a field camp to support balloon operations. Launch site position is on or about 77.86 degrees South Latitude and 167.13 Degrees East Longitude and near sea level. A single circumpolar flight trajectory is nominally 9 to 12 days, traveling to the west, and typically bounded between 73 to 82 degrees south latitude for balloon float altitudes of 115,000 to 130,000 feet. (See Figure below.) For mission planning purposes, logistics requirements are quite stringent; therefore, experiment, payload, and ground support equipment must be flight ready prior to departure from the United States. Logistics, housing, meals, and other on-site support is currently provided by NSF (National Science Foundation) who has responsibility for management of U.S. sponsored polar programs in Antarctica.

Launch operations are normally conducted from about 1 December through 10 January each year and flights may remain aloft as late as 21 January. It is possible to circumnavigate the pole more than once during the same flight but this capability has yet to be demonstrated. Experimenters desirous of being considered for a flight that includes two or more circumpolar trajectories should develop plans for mitigating the additional risk associated with such missions. They should also plan to be flight ready by 1 December in order to allow sufficient time to conduct a longer mission, allow for launch delays, and account for logistics support from National Science Foundation in recovering the payload.

Antarctica FY95 LDB



Experimenter/Organization: Dr. Robert Lin/University of California, Berkeley
Date Launched: January 8, 1995
Launch Site: Williams Field, Antarctica
Balloon Size: 29.47 million cubic feet
Suspended Weight: 4,750 lbs
Float Altitude: 122,500 ft
Total Flight Time: 23 days, 23 hours, 42 minutes

Fairbanks, Alaska:

Fairbanks is located about 64.67 Degrees North Latitude and 147.07 Degrees West Longitude. Launch operations are normally conducted between 1 June and 10 July of each year. Flight trajectory is to the west with a single circumglobal route bounded between 60 degrees and 70 degrees north latitude for a 9 to 12 day mission that is terminated over Canada. Nominally, average float altitudes of approximately 115,000 feet can be expected with diurnal variations of +/-10,000 feet.

Alice Springs, Australia:

Alice Springs is located at 23.80 degrees South Latitude and 133.88 degrees East Longitude. Launch operations are normally conducted between 1 January and 15 February. Flight trajectory is to the west with a circumglobal route bounded between 28 degrees and 19 degrees south latitude for a 6-9 day mission that is terminated in South America. Float altitudes of 120,000 to 130,000 feet can be expected during the day with significant excursions of 20,000 to 30,000 during the night. Occasional descents to approximately 75,000-ft. altitude during nighttime periods may be experienced due to storms.

Launch & Flight Operations

LDB Weights:

The following weight information is provided for determining total gondola weight, stress analysis for structural paths, etc. These weights will vary depending upon specific upper antenna boom requirements, PV array size requirements, antenna cable lengths, etc.

-Sip and Thermal Shield	380 lbs.
-Ballast Hopper / Load Cell / Ballast Valves	23 lbs.
-LDB Solar array	130 lbs.
-PV Panels	
-Support Frame	
-Various Sensors & Antennas	
-Upper Antenna Boom / Antennas / Cabling	40 lbs.

Maximum Allowable Science Weights

Antarctica	**3000 lbs.**
Fairbanks, Alaska	**3500 lbs.**
Alice Springs, Australia	**2000 lbs.**
Super-Pressure	**130 lbs.**

Although the gross inflation launch limits are lower for Antarctica, a larger amount of science weight is allowed than for Australia. (Gross inflation is the sum of balloon weight, total suspended weight below the balloon and free lift). This is due to the relatively stable thermal/radiation environment of continuous daylight and overflight of icy surface terrain in Antarctica. Australia flights require significant ballasting due to encountering periods of both day and night and overflight of a variety of surface terrain. Flights from Fairbanks, Alaska, although also conducted in near continuous daylight, cover a wider variety of surface terrain than in Antarctica, both land and water, and thereby require some provision for additional ballasting. This has a negative impact on allowable science weights.

Launch Vehicle Restrictions in Antarctica:

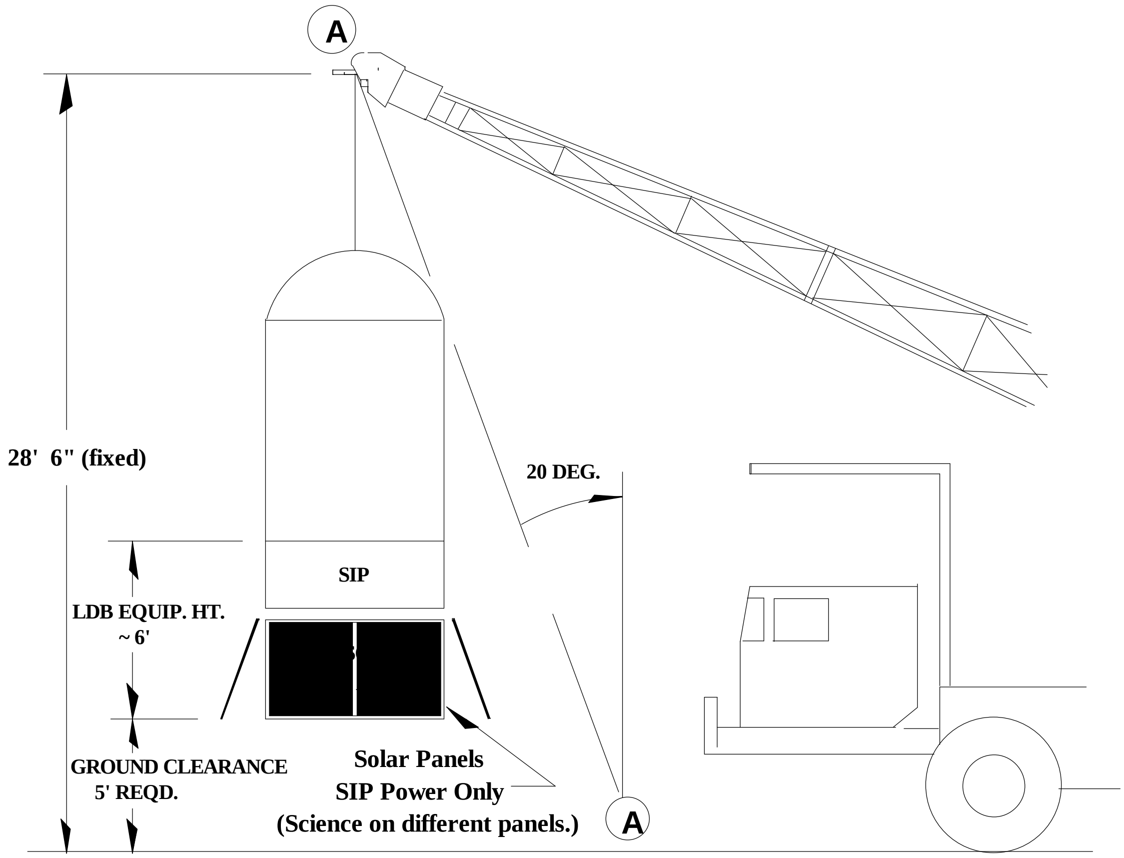
For each Antarctic campaign, a launch vehicle is temporarily created by mounting a payload support structure on an all-terrain truck borrowed from the U.S. Antarctic Program's vehicle fleet at McMurdo Station. Because of the limited suspended load carrying capacities of that truck and the snow surface on which it operates, NSBF's launching capabilities in Antarctica are more limited than they are elsewhere. Analysis shows that these loads can be safely managed for the Antarctic launch vehicle only if the gross inflation does not exceed 9500 lbs. As a result, tradeoffs between payload mass and balloon volume/mass can be made provided that the 9500 lbs. gross inflation number is not exceeded.

In addition to the 9500 lbs. gross inflation limit, there are also dimensional and geometric limitations on Antarctic launches. These limits are illustrated in the accompanying diagram of an LDB payload suspended on the Antarctic launch vehicle. The diagram should make the following points clear:

1.) The height of the payload suspension point on the launch vehicle is fixed at 28 feet 6 inches above the ground surface.

2.) A minimum ground clearance of 5 feet between the ground surface and the lowest point of the LDB payload is required.

- The combined height of the LDB Support Instrumentation Package (SIP) and the LDB omnidirectional solar panel array is approximately 6 feet. The SIP has been shown in the diagram mounted externally at the base of the science gondola. Other mounting configurations for the SIP may be possible.



- The line, marked "A-A", describes a plane, which delimits acceptable and unacceptable payload geometry. Experience has shown that any payload element, which extends above and to the right of the “A-A” line, will strike the underside of the boom during the launch.

Any requirements exceeding those mentioned above will need to be identified at the time of the proposal. The costs associated with providing support beyond those listed above will have to be identified as additional costs in the proposal.

Termination and Recovery

The flight can be terminated by command or by on-board flight control systems. The flight can be terminated for any number of reasons such as balloon vehicle problem, successful conclusion of the science mission, prevention of over-flight of inhospitable territory, etc. In many cases the payload is recovered with minimal damage and refurbishment costs. In some cases where the payload was terminated near the launch site, the payload has been able to be refurbished and reflown.

The payload is suspended below a flat circular parachute, which is fully deployed below the balloon. At the time of termination, a command is sent which releases the parachute and payload from the balloon. (Opening shocks of up to 10 times the suspended mass must be accommodated for in the design. Additional details for structural design requirements can be found in LDB Flight Application.) The payload and parachute then descend to the surface and impacts with a terminal velocity of 20 ft/sec or less. Upon impact, a parachute cutaway command is sent to separate the parachute from the payload to minimize risk of damage to the payload due to dragging. A recovery crew is dispatched and guided to the payload, which is then recovered and returned to a designated site for later shipment.

Recovery Requirements:

Antarctica:

From a science, economical, and environmental standpoint, it is highly desirable to recover 100% of the payload. To date only one gondola has been recovered utilizing the LC-130 aircraft. This is largely due to availability of the aircraft (the LC-130) and accessibility near the impact site due to surface conditions for landing. Most recoveries are done with a Twin Otter or helicopter. Making use of the Twin Otter, each discipline must be aware of the usable space, configuration and load capacity (~2200 lbs.) with this aircraft. The helicopters have a very limited inside cargo carrying capacity and can sling loads up to 1,800 lbs. Several trips are required for a complete recovery using either of the two aircraft above. With this information, each science group should be building payloads such that they will break down into components that will fit in the Twin Otter or helicopter. Various components must withstand extended periods of time exposed on the Antarctic surface waiting for a recovery to take place. **Payloads built with a single source recovery aircraft in mind, i.e. LC-130 Hercules, run the risk of not getting their payload recovered.**

Fairbanks and Alice Springs:

Normally, recovery for mid-latitude type launches will be handled in much the same manner as currently done for conventional ballooning. Various helicopter and ground recovery assets will be used. Gondola design should take into account ease of recovery in remote locations which often require helicopter lifts.

Flight Environment

The thermal environment is significantly different than the typical Spacecraft environment. Balloons are more closely coupled with the atmospheric and ground environment than Spacecraft because of the relative velocities to the surface, as well as proximity to surface. As a result, flights in mid-latitude regimes can experience periods of darkness and daylight of up to 12 hours. These extended periods of light and darkness must be designed for. Antarctic missions are in constant daylight throughout the mission, with an additional high albedo loading coming from the icy surface. The thermal analysis techniques and control methods employed for ballooning are fairly well established and have been proven on many flights. Most of the control methods are passive and do not require thermal blankets or complicated active systems. The required power allocation for thermal control may be higher than for a typical Spacecraft.

The following values can be used as general guidelines for the balloon environment, but actual values will need to be determined based upon flight requirements as contained in the LDB Flight Application.

Balloon Vehicle:

Balloon Ascent Rate: typical 800-1200 fpm
Balloon Rotation Rates *: typical < 60 deg/min at float; have seen during ascent/descent ~ 180 deg/min (* Information for pointing systems design)

Loads:

Launch: typical < 1.5 g's
Ascent: typical < 1.1 g's due to wind shears, ballast drops, etc.
Terminate: typical < 10 g's
Impact Velocity: typical < 20 fps

Atmospheric:

Tropics: -90C @ ~ 50-60 k-ft altitude
Polar: -45C @ ~ 30-35 k-ft altitude
Mid-latitude: -55C @ ~45-60 k-ft --> -80C in summer (seasonal & latitudinal fluctuations)

Radiation:

Solar Constant (seasonal): 1358 W/m2 (nominal)
1312 W/m2 (minimum)
1404 W/m2 (maximum)
Albedo: 0.1 (minimum)
0.9 (maximum) polar
Earth Flux: 90.7 W/m2 (minimum, cloud top temperatures of 200K)
594 W/m2 (maximum, Desert @ 320K planet temperature)

LDB Ground Stations

The ROCC (Remote Operations Control Center - launch site) and OCC (Operations Control Center - Palestine, TX) provide similar capabilities. The Science GSE Computer to LDB GSE Computer interface is the same for both the ROCC and OCC configurations. The ROCC is used at both the Antarctica and the Mid-Latitude launch sites; however, at the Antarctica site, the ROCC is the primary NSBF Operations Control Center from launch to flight termination. For mid-latitude flights, the ROCC is the primary NSBF Control Center during launch. After the balloon reaches float altitude, and prior to it leaving the launch site TM coverage range, Operations Control is handed over to the OCC at Palestine. Scientists have the option of establishing their own Science GSE at their home institution, however, any commanding through NASA systems are required to go through the ROCC (Remote Operations Control Center - launch site) and OCC (Operations Control Center - Palestine).

For Antarctica missions, the ROCC is the primary command and data retrieval station. However, the experimenter is strongly encouraged to take advantage of the INMARSAT-C data, which is available at the OCC during Antarctica missions. This data supplements that which is available in Antarctica and does not have the problem with obscuration and blackout periods each day which affect the Antarctica ROCC. Antarctica flights may be commanded from the OCC via INMARSAT-C; however, HF commands may be sent only from the ROCC for Antarctica missions.

The OCC in Palestine is the only point of interface for the experimenter requiring TDRSS support. All TDRSS return telemetry and forward commanding is available only at the OCC. In addition, Mid-Latitude data from Argos and INMARSAT-C is also available at the OCC. Forward INMARSAT-C commands can be sent from the OCC for any region of flight operation.

Payload/Launch Vehicle Integration

<u>Antarctica:</u>

Because shipment of equipment is due out by mid August, pre-deployment integration at Palestine must be concluded by the end of July each year. Following this integration and compatibility testing, a Mission Readiness Review (MRR) is conducted prior to shipment to assess the readiness of both the experimenter and NASA. It should be understood that all equipment is shipped directly from the NSBF to Port Hueneme, CA following pre-deployment integration. No configuration changes to the science experiment or the support systems are allowed following integration unless so directed by the Mission Readiness Review technical panel.

Shipping of all NSBF equipment in support of each year's campaign is no later than middle of August in order to allow time for equipment to arrive at Port Hueneme, California for ocean shipping to New Zealand and then to McMurdo by air. Although NSBF arranges for shipping from Palestine to Port Hueneme, experimenters are expected to provide proper shipping containers and to execute the packing. NSBF ships heavy items such as balloons and helium to McMurdo one-year in advance so special balloon configuration requirements must be identified early allowing the balloons to be built in time to meet shipping schedules.

Fairbanks:

Pre-deployment integration at Palestine will be normally concluded by the middle of April. A MRR will be conducted following integration and compatibility testing to assess readiness prior to shipping of equipment to Fairbanks. It should be understood that all equipment is shipped directly from the NSBF to Fairbanks following pre-deployment integration. No configuration changes to the science experiment or the support systems are allowed following integration unless approved by the Mission Readiness Review technical panel.

Alice Springs:

Pre-deployment integration at Palestine will be normally concluded by the first of October. A MRR will be conducted following integration and compatibility testing to assess readiness prior to shipping of equipment to Australia. It should be understood that all equipment is shipped directly from the NSBF to Australia following pre-deployment integration. No configuration changes to the science experiment or the support systems are allowed following integration unless approved by the Mission Readiness Review technical panel.

Planning, Budgeting, and Other Miscellaneous Information

For planning and budget purposes, the following costs for Balloon Program standard services on long duration balloon missions may be used. The numbers are in 2000 dollars and inflation rates as outlined in Appendix B should be applied to obtain costs for the year flight support is required. Costs are predicated on the continuing level of infrastructure in the Balloon Program.

LDB Campaign Costs - FY00 Dollars

*McMurdo, Antarctica	Alice Springs, Australia	Fairbanks, Alaska
$885K	$1350K	$1145K

The costs presented above were developed to cover nominal services required to conduct one LDB science mission with a SMEX payload and include the following:

- Integration and functional ground testing at Palestine, TX.
- Shipping of user and National Scientific Balloon Facility equipment from Palestine, TX, to the launch site.
- Travel, per diem, and overtime costs for NSBF operations personnel.
- Balloon and helium sufficient to perform one flight operation. A back-up balloon and helium will be made available for the user, if needed. The user will be charged for the back-up balloon and helium only if they are used.
- All equipment rental required by NSBF operations personnel at the launch site.
- The provision and operation of standard LDB ground control, tracking and data acquisition systems at the launch site and Palestine, TX, when required.
- Communications costs, both for voice and satellite data uplink and downlink.
- Nominal recovery utilizing the launch site as a base for operations. Effecting recovery in another country that requires a second operations team and/or additional tracking and recovery equipment might involve additional costs.
- Normal on-board mechanical support hardware utilized by NSBF operations personnel to conduct launch, flight, and recovery operations.
- All other miscellaneous hardware required by the NSBF operations personnel.

The costs presented do not include the following:

- Any test flights. A test flight is not required but highly recommended.
- Any electrical or electronic hardware required to support either NSBF or user requirements. Some minimal version of the SIP that has been designed and built for standard LDB flight operations will be required by NSBF operations personnel for balloon flight tracking and control. A small inventory of standard SIP’s exist which was created to support traditional LDB users in the Balloon Program. Three versions of the SIP have been built: two for polar applications and one for non-polar applications. These SIP’s will meet the requirements of the NSBF and might meet the requirements of the SMEX user as well. However the SMEX user would have to compete for its use along with the other LDB candidates. Furthermore, any damage or loss of the borrowed SIP would have to be covered by the SMEX user. It is highly recommended that the SMEX user plan to fund the construction of a new SIP which would be tailored as much as possible to his specific requirements and which would be dedicated to his support. (The statements above on LDB SIP’s concerning availability, use, and refurbishment/replacement also apply to LDB rotators.)

- Any other special requirements or out-of-pocket costs not specifically addressed here.

For the purpose of estimating, the following additional cost information is provided for standard SIP's, built by PSL to NASA requirements, deemed acceptable for SMEX missions, and provided by the NASA Balloon Program (FY00 Dollars.) Also included is costing information for what is called a Mini-SIP (which is normally used for LDB flight testing purposes in lieu of a more expensive full up SIP), A LDB Sun Pointing Rotator, and test flights at Palestine, TX and Ft. Sumner, NM.

- Polar SIP (With HF-ARGOS/INMARSAT)	- $450K
- Polar SIP (With HF-ARGOS/TDRSS)	- $1,100K
- Non-Polar SIP (With TDRSS/INMARSAT)	- $1,100K
- LDB Sun Pointing Rotator	- $70K
- CONUS Test Flight (Palestine)	- $125K
(Ft. Sumner)	- $150K
- LDB Mini-SIP (Used on Test Flights to emulate the SIP)	- $75K

Test flights are not a requirement of the NASA Balloon Program. However, prior to deployment for an LDB mission, demonstrated performance of new systems, scientific and flight support alike, in balloon flight environment is highly recommended.

Any SIP bought by the proposer will become the property of the proposer. The proposer has the option of going to any source for the design and fabrication of a SIP or integrated payload. However, the requirements previously delineated in Future Capability on page 6 of this document will be maintained. For emphasis those requirements are repeated here. “An additional feature of ULDB will be an integrated approach, similar to that of Spacecraft, to the design of the science and flight support systems. Proposers will be allowed to develop an integrated approach for the payload, i.e. no separate SIP package. However, proposers are advised to be cautious in using this approach because LDB requires that all flight control systems be electronically and electrically (including power), and thermally isolated from the science systems. Any integrated science approach would have to meet these requirements. Also LDB requires that all flight control systems must have a demonstrated performance record in balloon flight environment and be approved for operational flight use by the NASA Balloon Program. The only systems that meet these requirements are those currently being flown on NASA LDB flights”.

Multiple flights may be proposed under this Announcement of Opportunity. The current LDB mission model consists of two two-flight campaigns each year; one in the Northern Hemisphere in the late June - early August time frame and one in the Southern Hemisphere, either Antarctica or Australia, in the December-February time frame. There are no known technical restraints associated with multiple flight proposed within this model. However all flights, regardless of number require the approval of NASA headquarters. Due to the possibility for a wide variety of multiple flight scenarios, estimates for a multiple flight scenario cannot be provided until the proposer defines the multiple flight requirements. It is highly recommended that proposers request information for assistance in budgeting for multiple flights and launch support services in proposal preparation.

The NASA Balloon Program levies no requirements on users for special facilities, equipment, or services. Any non-standard services for mission unique requirements identified by the user should be included in preparation of the cost proposal. Any reasonable request for use of existing permanent facilities within the NASA Balloon Program at Palestine, TX, Ft. Sumner, NM, or Wallops Island, VA, will be provided at no cost to the user. The Balloon Program will also arrange and pay for normal build-up, launch, flight and recovery facilities and equipment required in support of the mission. Mission unique requirements for specialized equipment, support or facilities that are not currently provided by the Balloon Program infra-structure must be identified and accounted for separately in the cost proposal. Examples of a mission unique requirement is the requirement for a clean room for payload preparation at a launch site such as Antarctica where such facilities do not exist; or specialized handling equipment for the Ballooncraft. The only existing facility uniquely tailored to LDB requirements is the combination Integration, T&E, and LDB Control Center located at Palestine, TX.

All questions for the NASA Balloon Program should be directed to the SMEX Program Scientist for appropriate action as specified in the AO.